INSTRUCTIONS FOR COLLECTORS

Museum of Comparative Zoology

AT HARVARD COLLEGE

Reprinted from

HARVARD TRAVELLERS CLUB
HANDBOOK OF TRAVEL

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SHIPPING INSTRUCTIONS

Foreign shipments should be sent in bond to the

MUSEUM OF COMPARATIVE ZOOLOGY

c/o Stone and Downer

Boston, U. S. A.

Domestic shipments should be addressed simply to the

MUSEUM OF COMPARATIVE ZOOLOGY

Cambridge, Massachusetts

Covering letters, in either case, should be addressed directly to the Museum, in Cambridge.

CHAPTER XX.

NATURAL HISTORY COLLECTING.

Travellers in out-of-the-way places may frequently add to the interest of their journey as well as make valuable contributions to knowledge by sending back specimens to museums of universal scope. Harvard men especially may be reminded that the University Museum, the Gray Herbarium and the Farlow Herbarium at Cambridge maintain extensive study collections of animals, plants, fossils, and minerals, to which such contributions are welcome. The value of specimens depends in large part on the care taken in their preparation and the accuracy of accompanying data as to locality, date, and other pertinent facts which should be recorded on a label made at the time of collection and attached to the specimen or accompanying it. While field collecting is often a specialist's task, the amateur, by following simple directions, may preserve much that is of value.

MAMMALS.

By Glover M. Allen.

Small Mammal Equipment. For really serious collecting will be needed: a light but strong fiber trunk of small size, with close-fitting trays varying in depth from one to three inches; scalpels, scissors, sharp-pointed and longer, blunt forceps; needles, thread, large and small, common pins, and labels; cotton, the best absorbent in pound packages, wire preferably noncorrosive of Monel metal larger and smaller.

Labels should be of tough paper, bond paper, and not too large lest they catch, 2 x ½ inches is about right for small specimens,

and small baggage tags may be used for hides and large skulls (avoid surfaced linen tags as the surface comes off when wet). India ink is best for all writing.

For a preservative, saltpeter and alum (an ounce of alum to a pound of saltpeter) powdered and well mixed is good, and less deliquescent than common salt. Neither will prevent the ravages of insects, which must be kept out by a plentiful supply of napthaline flakes. Arsenic in the form of arsenical soap applied on the inside of a skin prevents attacks of pests, but is poisonous and, in the dry form, is often mistaken for sugar or salt. A millimeter rule and dividers are needed for measurements.

For small mammals, traps of mouse and rat size are essential. The "Government" mouse trap of the snap-over style with a larger base than the regular commercial one causes less frequent damage to skulls. They can be made to order in lots of a gross or over, from The Animal Trap Co., Lititz, Penn.

All-metal folding rat traps in boxes of a dozen are made by J. P. Schuyler Co., Bloomsburg, Pennsylvania. For bait, a mixture of rolled oats, chopped raisins and bacon, mixed with enough peanut butter to form a stiff dough, lasts well and will not blow away. Put "a pinch" on the bait-treadle of each mouse trap when setting. For rat traps, nuts, raisins, or a piece of meat may be used. An excellent pamphlet by H. E. Anthony giving full instructions for making study skins is issued at 15 cents by the American Museum of Natural History, New York City.

Making Study Skins of Small Mammals. The specimen is first to be measured: total length; length of tail held at right angles to the back and exclusive of the terminal hairs; hind foot from heel to tip of longest claw; height of ear from lower border of opening to the tip. Measurements and collector's number; the sex; place, and date are entered on the back of the label. In all cases the skull must be preserved separately and given a corresponding number.

Slit the skin of the belly from chest to anus avoiding cutting into the thin belly wall; peel the skin back as far as possible on each side; push the hind leg forward through the cut and sever at the knee. Loosen the skin all around the base of the tail. Then, by holding the nail of the thumb and forefinger firmly at its base, the bone can usually be slipped out by a firm pull. Continue now to strip the skin back over the body to the fore limbs, which are severed at the elbows, and the skin worked forward over the head. Cut carefully through the *bases* of the ears, and through the eyelid

close to the skull. Finally, cut through the lips *close in* and through the cartilage of the nose, thus removing the skin. The lips should now be caught together by a stitch from inside and the flesh cleaned from the forearm and lower leg leaving the bone in. Layers of fat or connective tissue adhering to the skin must be peeled away as far as possible. Carefully avoid pulling on the skin because it stretches easily. Dust the skin in the preservative, and turn it back right side out. A wisp of cotton fills out each of the limbs, or the cotton may be wrapped about the leg bone. The rest of the skin should be filled out with a fairly firm body of cotton, best made by shaping a pointed strip of the cotton slightly larger and longer than the original body and thrusting its pointed end to the nose of the skin with the long forceps. Then tuck what remains into the body of the skin. For the tail, cut a piece of wire of suitable size and wrap it to about the size needed by twisting a few fibers of cotton about its tip, and twirling it in the fingers of one hand. Wind on enough at the other end of the wire to fill out the tail-skin. Then thrust the wire carefully to the tip of the tail from inside. Now, sew up the opening in the belly of the skin, tie the label to one of the ankles, and pin the skin out, back up, on the bottom of one of the wooden trays of the collecting chest to dry. Be sure that the feet are brought against the side of the muzzle in front and to the tail behind lest they project, catch, and take up extra space.

The skull and teeth are of great importance in classification and must be carefully preserved. Sever the skull from the body, carefully remove the eyes, tongue, and as much of the muscle mass as can easily be done. With a loop of wire, hook out the brain through the large opening at the base of the skull, being careful to break no bones. Attach a label to the lower jaw, bearing the same number as the skin, and string with other skulls on a wire to keep them all together and to dry. It is better to keep skins and skulls apart because insect pests are attracted by the dried skulls. Never put skulls in a tin box because the dampness causes decay and odor. Keep them in wooden or paper boxes, with a sprinkling of naphthaline flakes.

Large Mammals. To remove the skin, run a cut from chin to end of tail along the mid-ventral line and, from this line, along the inside of each leg to the tip of the foot. Peel off the skin, taking care to cut away tissue instead of pulling, lest the hide be unduly stretched. Cut through the bases of the ears, the eyelids, and the lips as close to the bone as possible to avoid slits in the skin. If the skull is

large, or with horns, it is removed by connecting the bases of the horns by a cut, severing the skin all around the horn bases and extending the slit on to the nape sufficiently to allow the removal of the skull through it. The large ear cartilages must be dissected out by carefully loosening the skin at the base of the ear from the inside and turning the ear inside out, leaving the cartilage attached as a shell to the inner half of the ear, as far as the tip. If this is not done they cannot dry properly and the hair will slip on the backs of the ears. Remove so far as possible, all fat and connective tissue from the inner surface of the skin, and open the feet to the ends of the toes. All fleshy pads or parts that will not dry easily must be slit and salt rubbed in. Now rub handfuls of common salt well into every part, working it down to the tips of the toes and into the lips, and ears, then fold the hide up, hair side out, and set it aside overnight or for several hours so that the salt can draw the water from the skin and penetrate to every part. In the morning, unfold, drain off the accumulated liquid, rub more salt into any parts that seem to need it, and hang up or spread out to dry *slowly in the shade*. In rainy times it may be necessary to hang near a very low fire to facilitate drying, but never in the smoke or too near heat, lest the hide will become hard and brittle. Change its position and examine frequently lest it dry too fast. When nearly dry, roll up, hair side in. On the march, the salted hide can be unrolled and spread out when making camp, and, when finally dry enough, tie it up in a compact bundle. Be sure to tie the label on while salting and in a place where it can be seen when the hide is too stiff to permit unrolling. Preserve the skull as before by removing brains and as much tissue as possible, and drying in the sun, but where dogs or vultures cannot reach it. The label must bear the same number as the salted hide. Wrap the tips of the jaws with heavy padding and tie the lower jaw in place. Otherwise, the teeth and slender bones will almost invariably be broken in travelling. Dry, salted hides are best rolled while green into small compass and packed in "chop boxes" with a liberal sprinkling of naphthaline flakes. They should be examined at intervals to make certain that they are free from insects.

Game Trophies. For heads to be mounted as trophies, it is best to make the cut along the top of the neck instead of down the throat for better appearance. In the case of heads having horns, this cut is extended to the base of each horn, the skin severed all around each base, and the skull removed through the cut. If the

head alone is wanted, cut the skin as far back on the neck as possible to allow for lapping under when it is mounted. Measurements of girth at the top, middle and base of the neck are a help in mounting. A certain amount must be pared off from the inner side of a very thick hide to make it thin enough for the salt to penetrate as well as to eliminate weight and to facilitate packing.

BIRDS.

By Glover M. Allen.

The ability to prepare a presentable bird skin can be acquired only with practice. The objective is to remove the flesh and other soft parts and replace with a firm body of cotton, so that when finished the specimen looks like a freshly killed bird, lying on its back with the wings folded in a natural manner at the sides.

For collecting the smaller birds, a small-bore shotgun of .410 or .44 caliber or 16 gauge, or a long-barreled pistol using shot cartridges, is useful. For all-round use, a 12-gauge shotgun with an auxiliary barrel is very satisfactory, the latter consisting of a steel cylinder about seven inches long fitting like a cartridge into the breech, and bored to take a small-caliber shell.

For collecting in dense thickets, a bird net of fine, dark twine having about a two-inch mesh can be stretched in an opening. It often secures secretive species that might not otherwise be found.

Immediately after shooting a specimen, thrust a small wisp of cotton wool down the throat and plug shot holes similarly, especially an injured eye, to prevent fluids from damaging the plumage. Then, place the specimen head down in a paper cornucopia, fold over the ends of the latter, and lay it in some sort of carrying bag or basket.

Skinning Equipment. The same tools are used as listed for small mammals' skins. A good supply of an absorbent for dusting exposed or moist surfaces of the specimen and absorbing grease, blood, etc., is almost a necessity. Corn meal (in a five-pound waterproof bag) is the best; dry sawdust will do, but becomes enmeshed in the feathers.

Skinning Directions. Lay the bird back down on the table and, with knife or scissors, make an incision from top of breast bone to vent, taking care not to cut through the thin belly walls (if this happens, plug with cotton and sprinkle corn meal in the cut). Without pulling on the skin, work the edges back with knife and finger

nails to expose the forward parts of hind legs. Push each leg forward into the cut, loosen the skin all around and sever at the knee. Split the muscle mass of the lower leg, turn it back from the bone to the ankle, and snip it off at the tendon leaving the bone in the skin for strength. Now, loosen the skin around the base of the tail, cut through the anus and then through the base of the tail far enough forward to avoid the bases of the tail feathers. Otherwise, these will fall out. Holding the body head down in the left hand, carefully strip the skin forward, feather side in, to the shoulders. Cut through the muscles and bone of the upper arm close to the body, and having thus reached the neck, continue to peel back the skin gently to the base of the skull. With forceps, carefully pull out the pocketlike skin lining the ear cavity, and work the skin forward over the eyes. The thin skin of the eyelids must be severed close to the orbit in order not to cut through the feathered portion of the lids. The skin is now inside out to the base of the bill. With forceps, remove the eyes from the sockets; then, with scissors, run a deep cut along the inner side of each jaw through the palate to the back of the skull. Join these two cuts with a cross cut through the back of the skull and remove the enclosed piece which carries with it the tongue and muscles as well as part of the brain. Finish cleaning the skull of as much brain and other tissue as possible. Dust with preservative and fill each eye socket with a pellet of cotton. Then reverse the skin, working the bill and head back through the neck. After working the skin free from the "arm bones" of the wings with scalpel and finger nails, remove as much flesh as possible. In large birds, the forearm should be opened from the under side of the wing and after clearing away the muscles and tendons, they can be replaced with cotton and the skin stitched together. The arm bones must be left in for support. The legs of large birds have powerful tendons on the back of the shank. These must be removed by making a small incision through the skin just above the toes, inserting the forceps and pulling the tendon through.

Having cleaned the inside of the skin of any masses of fat or flesh, with needle and thread catch together the tracts of feathers on the shoulders from inside, draw them to about the natural distance apart, and tie the thread. This prevents the skin from being too wide across the shoulders. Various ways of making an artificial neck and body are advocated by collectors. For small birds, a toothpick or small stick wrapped in cotton to required size is

thrust through the neck to the brain cavity. It makes a firm neck. A second piece of cotton compacted into a form like that of the carcass is then inserted in place of the body, and the cut edges of the skin sewn up. The feet are crossed, the label is tied to them, and the bill is held together by taking a stitch through the nostrils from side to side and tying the ends over the lower bill.

After being smoothed and the wings arranged in natural position at the sides (a pinch across the shoulders will help), the skin must be wrapped in a thin sheet of cotton batting. To do this, it is laid on the diagonal of the sheet and the sides folded over to hold the plumage in place until dry.

More detailed instructions may be found in an excellent pamphlet by James P. Chapin entitled, "How to Make Study Skins of Birds," for sale by the American Museum of Natural History, New York City; price 25 cents.

Books on Natural History Collecting.

Anderson, R. M. "Methods of Collecting and Preserving Vertebrate Animals." Bull. No. 69, Nat. Mus. Canada, Biol. Series No. 18, Dept. of Mines, Ottawa, v, 1932.

(An excellent manual for the traveller.)

Anthony, H. E.: "The Capture and Preservation of Small Mammals for Study." Guide Leaflet No. 61, Amer. Mus. Nat. History, New York City, 53 pages, illustrated, 1925.

(Of pocket size and invaluable as a guide in collecting study specimens.)

Chapin, J. P.: "Preparation of Birds for Study." Guide Leaflet, No. 58, Amer. Mus. Nat. Hist., New York City, 45 pages, illustrated, 1923.

Hornaday, W. T.: "Taxidermy and Zoölogical Collecting." New York, 1891, 362 pages, 24 plates. C. Scribner's Sons.

(Though somewhat out of date, is excellent reading and full of practical advice.)

Various contributors: Directions for collecting and preserving specimens. Bull. United States Nat. Mus., Smithsonian Institution, No. 39, Parts A–S, 1891 to 1911.

(Consists of brief separate papers giving instructions for collecting in nearly all branches of natural history.)

REPTILES AND AMPHIBIANS.

By Arthur Loveridge.

In general, it is the smaller species that are most interesting. Large individuals of snakes or lizards take up more room and show little that is not equally discernible in smaller specimens. Small lizards are collected with the aid of a 22-caliber pistol or collecting gun, shooting a small charge of fine shot (shot cartridges of this caliber are obtainable at gun shops). Burrowing forms are especially desirable. Frogs are often hidden by day but become active at night. They may then be captured with a hand net by the aid of a flashlight at the edges of pools or in damp woods. In the tropics, they can often be disclosed by slitting down the long sheath-like bases of banana leaves inside of which they take refuge.

Equipment. Stout cotton bags with draw strings, and of various sizes for carrying specimens in the field; chloroform (in metal cans) for killing; tight, friction-top tin cans for holding the specimens can be made in pint or quart sizes and nested together until used. For a preservative, carry ordinary commercial formalin in a well-protected bottle or can.

Directions for Preservation. Frogs are very susceptible to chloroform. To kill the specimens, the bag containing them may be dropped into a friction-top can and a few drops of chloroform sprinkled on before the can is closed. Afterward, each specimen should have the slime washed off and they should then be left to soak in a bowl of water overnight (protected from predatory rats or cats, if these are about). Next morning, drain off the water and immerse the specimens in a bowl or tin containing five parts of water to one part of formalin (by volume). Do not overcrowd them at this stage. Allow them to soak for forty-eight hours. Then, having lined the friction-top tin with paper (formalin will rust the tin and the specimens in contact with it will be soiled), pack the specimens between layers of rags or cotton and fill the tin with the formalin solution. The locality, date, and other notes should be clearly printed *in pencil* on stout paper, folded so as not to become defaced (formalin destroys all paper in six months), and placed inside each tin. If specimens from several localities are placed in one can, each lot should be separately wrapped in cheesecloth with its label.

Lizards, up to fifteen inches long, are treated in the same way

but, before soaking, make a small incision in the belly to permit penetration of the formalin. With large specimens, it is advisable to make cuts in the lower side of the tail and limbs for the same purpose.*

Snakes are similarly preserved but several slits should be made along the underside of the body at three-inch intervals to insure penetration of the formalin. Usually, specimens over three feet long are less desirable, as taking up too much valuable space. Larger snakes may be slit the entire length of the belly and the body removed. The skin with head and tail attached is then rolled up and preserved in formalin.

If it is desired to mail specimens home, pour off the formalin from the friction-top tin. The sodden rags or cotton are moist enough to keep the specimens for at least a month. If they do not fill the container, pack the empty space with excelsior or damp rags to prevent them from shaking about and rubbing, but do not pack so tightly as to crush the specimens. The can may then be wrapped and mailed. A large number of specimens can be shipped in a Standard Oil tin, packed as described, soldered up and crated.

Fishes.

For collecting fishes, a small seine is useful. Along small streams, fish traps, sometimes obtainable from natives, can be set in barriers of sticks, and the pool "driven." Closed pools are sometimes poisoned by the use of copper sulphate. In many countries the native population may prove helpful in bringing in certain varieties, or a visit to the local fish markets will often provide a supply of the commoner or edible species. In general, alcohol is recommended as a preservative. If possible immerse first in a weak solution, about 50%, and after a day or so change to a stronger grade, 60% or 70%. Formalin can be used, but its effect is to render the fish so hard that it is useless for some purposes. For packing and transporting, friction-top tins as recommended for reptiles are good. Glass jars are heavy and breakable, so that if they must be used, they should be individually isolated by being tightly wadded about with excelsior in a wooden box.

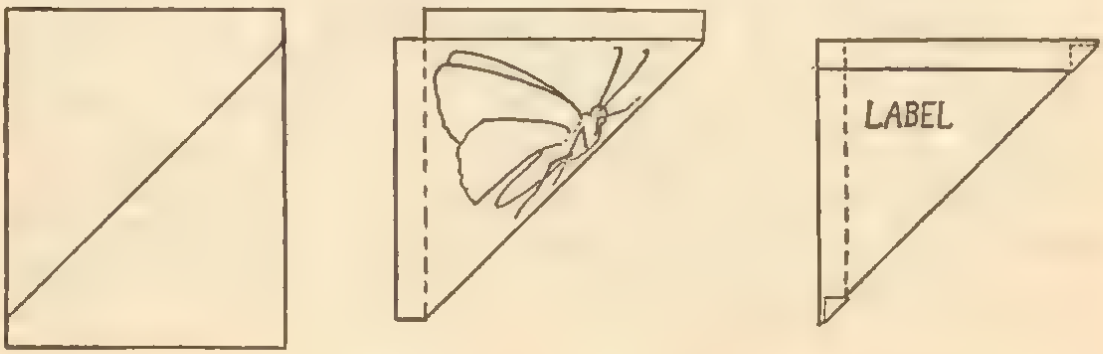
* The preservation of reptiles in formalin can be aided by injecting into different parts of their bodies a 10 per cent solution of formalin by means of a syringe and hollow needle, such as are used for the injection of antitoxin. I have seen this done by an eminent zoologist. (G. C. S.)

INSECT COLLECTING.

By Philip J. Darlington, Jr.

How to Preserve Insects. It is not necessary to carry complicated equipment in order to collect insects casually. A long-handled net and forceps are useful, but most insects can be caught and handled without them. Ants and beetles, as well as spiders, can be preserved satisfactorily in small bottles of alcohol. Denatured alcohol from any drug store or, in a pinch, even strong rum will do. Dry killing bottles are necessary, however, for killing most other insects. Standard entomological killing bottles charged with potassium cyanide can be obtained from entomological supply stores, but the traveller who expects to collect only occasionally will find acetic ether a more convenient killing material. Four ounces of the fluid will do for many days of collecting. Any tight jar can be charged with acetic ether fumes merely by wetting a small wad of cotton or paper with the ether and putting it into the bottom of the jar under crumpled newspaper, so that insects put into the jar will be exposed to ether fumes but will not become wet.

Insects which have been killed in alcohol may be left in it indefinitely. This is the best way to preserve ants and most beetles. Other insects, after being kept in a killing bottle overnight, should be packed dry. Flies, bees, wasps, and similar insects should be packed, without crushing, between layers of dry, preferably glazed cotton in small boxes, such as match, cigarette, or pill boxes. Metal boxes should not be used, and no box should be reopened once insects have been packed in it, for dry insects are very fragile until they have been properly relaxed. Butterflies, moths, dragon-



Explanation of Figures 12, 13, 14

Steps in papering an insect: 1. Oblong of paper, creased diagonally.
2. Paper folded, with insect inside shown as though paper were transparent.
3. Finished "triangle," with flaps folded over and creased in place.

flies, and dragonfly-like insects should be put singly into small envelopes or in "triangles" of newspaper, as shown in the figures. All bottles and boxes of specimens should be labeled plainly with locality, date, and collector's name. Boxes of dry insects should not be allowed to become damp. In very humid, tropical climates they should be slowly dried before a fire or in a drying box heated by an electric bulb, and should then be sealed against moisture, this time in metal boxes.

Where to Find Insects. Some of the best places to look for insects are on the flowers of shrubs and small trees. Not only bees and butterflies, but many wasps, flies, and brilliant beetles feed on flower nectar, especially on hot days and before thunderstorms. Freshly cut logs also attract many insects. Here, too, the best collecting is in hot weather, but, since many wood-boring insects are nocturnal, they should be looked for not only by day but with a light at night. A great variety of small insects can often be collected by "sweeping," or by driving a strong net through light vegetation, so that leaves or grass blades are knocked aside but insects which may be sitting on them are netted. "Beating," or clubbing foliage or dead branches so that insects are jarred off and fall into a big net or inverted umbrella, is an effective method of collecting, too.

Ground insects, among which ants and beetles are most numerous, are usually not so showy as arboreal species, but are just as interesting to the entomologist. Part of the ground fauna is active by day, but most species hide under logs or stones (where they may often be found) or in burrows during the day and run about at night. They can often be found with a flashlight or gasoline lantern. Ground collecting is often good on the shores of lakes, ponds, or streams. The best ground collecting, however, is during heavy floods, especially in arid country or after drought, for floods drive insects from their hiding places to high ground and into vegetation, or throw them ashore in drift. Small, artificial floods made by throwing or pouring water on to the banks of ponds or brooks, or by damming brooks, if one has a taste for engineering, often drive out ground insects.

Many insects fly or fall into the ocean on hot days in early summer and can be collected in the windrows upon sandy beaches. Sometimes, on hot days, flying insects accumulate in great numbers on the highest peaks of mountain ranges. Aquatic insects can be obtained by dredging along the edges of brooks or ponds with a

wire sieve or cloth net, especially where there is aquatic vegetation. Many nocturnal insects fly to light and can be picked up by the traveller under lights even on station platforms and hotel porches. Many scavenging insects are to be found on carrion and other decaying material. They are most pleasantly collected with forceps and put in alcohol. These are only a few of the places in which insects can be found. The success of an insect collector depends upon his imagination and powers of observation, which will suggest new sorts of places where new insects may be found, as much as upon his knowledge of traditional collecting places.

Entomologists are as interested in small, dull-colored insects as in large ones. The small ones are just as much worth picking up.

MOLLUSKS.

By William J. Clench.

Equipment. Small glass vials, glass jars or metal containers that can be tightly sealed and will answer for the preservation of most mollusks. A pair of forceps will aid materially in picking up the very small forms. Alcohol (60%), or even rum, will preserve the material sufficiently to get it to the museum without spoiling. Large specimens can be boiled and the soft parts extracted with a pin or fish-hook and the dried shells shipped in paper.

Methods. Specimens that are preserved in liquid should be held firmly in the container by crumpled paper or cotton to prevent breakage. Dried material can be wrapped in paper and packed in boxes or nail kegs.

Land snails of all sorts can be shipped alive without any preservation, as long as they are shipped in a *dry* condition. Free use of paper in packing will prevent any excess moisture from developing. Marine and fresh-water mollusks must either be preserved in spirits or boiled and the soft parts extracted before shipping.

Labeling. Much care should be taken to keep the proper data with the specimens because material without locality data has little value. Each container should be fully labeled, numbered or identified so that the proper data can be associated with the specimens from letters or notes explaining the shipment. The label can be rolled around the small vials and the two wrapped in paper. A good grade of stiff paper should be used for all labels placed within any container, especially if any sort of preserving liquid is used, and the data should be written in pencil.

Regions from which Material is desired. The Museum of Comparative Zoölogy (Harvard) is anxious to obtain material from everywhere outside of the United States. This is especially true of regions that are rather inaccessible and infrequently visited. Islands, particularly, are sources of valuable material, because isolated regions of this sort are usually populated with peculiar races or forms of a species that do not exist anywhere else. This applies to the land and fresh-water snails especially. Gather live material if possible; otherwise, fairly fresh specimens will answer.

PARASITIC WORMS.

By J. H. Sandground.

All classes of the higher forms of life, from the insects and mollusks, through fishes and reptiles to birds and mammals, are subject to parasitism. So large, indeed, is the number of kinds of parasitic "worms," that new species are constantly being discovered. It is rare in Nature to find an animal which has entirely escaped infection. Valuable material may be found while preparing skins of birds or animals. One who kills even the most common species of animals, and who will take the trouble to collect the parasites he is sure to encounter when he becomes acquainted with their many forms, will find very appreciative recipients for his material in any of the larger museums which support departments of helminthology. It is very desirable to have material that is collected adequately labeled as to its source (proper scientific name of the host, if possible, date and locality).

Parasitic Worms, their Habitats, and Classification.

Trematodes or "flukes" are usually internal parasites. They are unsegmented, frequently leaf-shaped, and they attach themselves to the tissues by means of sucking discs. They vary in size from microscopic forms to more than an inch in length. Fresh-water snails act as hosts for the larval development. The adult worms parasitize vertebrates. Certain species are found in the lungs, others in the bile ducts and blood vessels of the liver or other organs, and many species in the small or large intestine.

Cestodes or "tapeworms" are usually white, elongate, ribbon-like segmented animals when adult. They live by absorbing food from the intestine of vertebrate hosts and they attach themselves by hooks or sucking organs to the wall of the small intestine.

Special care should be taken to secure the "head" when removing the worms for collection. Some tapeworms are so small that they may easily pass unnoticed; others may be a yard or more long so that their presence is noted as soon as the gut is opened.

Nematodes or "threadworms" or "round worms" are more or less elongate, smooth round worms that are unsegmented. The parasitic species are very numerous. To detect many of them, the use of a good magnifying glass is necessary, but others can easily be seen with the naked eye and many of them attain considerable length. Practically all species of fishes, frogs, mammals, etc., may serve as hosts. The favored habitat is the intestine, but different species may be found in almost any part of the body.

Acanthocephala or "thorny-headed worms" resemble nematodes in outward appearance. They also exhibit a great range in size. The larval life may pass in an insect but the adult develops only in the intestine of a vertebrate. Here they attach themselves securely by means of a retractile proboscis armed with thorn-shaped hooks. As with tapeworms, care should be taken to avoid breaking off the head or hold-fast organ when collecting these parasites.

Some Favored Locations of Parasites in Birds and Mammals.

Even when heavily infested with parasitic worms, some animals will not appear sick or show obvious outward signs of the burden they carry.

Before skinning the animal, it is well to examine the eyes and orbits, the nasal cavity and the mouth.

In the process of skinning, it is not unusual to find parasites enclosed in cysts under the skin, around the tendons of the limbs or in the superficial muscles. Before eviscerating the carcass, wash the abdominal cavity and the inside of the thorax with physiological saline to detect worms lying free in these cavities.

Remove separately the liver, heart, lungs and trachea and the entire alimentary tract. So far as possible, examine these organs under saline solution. Examine the bile ducts and large blood vessels in the liver for flukes. In birds and mammals, nematodes may often be found in the lungs and the trachea or windpipe. Cut off and examine separately the esophagus, stomach, small intestine, caecum and colon. Slit these various parts with blunt or round-ended scissors and wash the contents into a large jar of water. Stir the mixture well, pour off the supernatant liquid and

examine the sediment in a glass or black enamelled dish. Then carefully examine the lining of the intestine for smaller worms that may still be attached. In birds, the horny lining of the gizzard should be stripped as it is often undermined with sinuous tunnels produced by small colorless or red nematodes which may be extracted with fine forceps.

Equipment and Methods of Preservation.

The equipment necessary for collecting parasites can be reduced to very small proportions and much of it is contained in the ordinary skinning kit. In addition to the usual scissors, scalpel and forceps, the following items will come in handy: simple hand lens; several eye dropper pipettes; a couple of needles, mounted on sticks; small brass spirit lamp; glass or black enamelled photographic developing dishes (about 8″ x 10″ size); a few stout-walled test tubes and *a good supply of small bottles and vials of various sizes with good cork or rubber stoppers to fit.*

For killing and preserving the various classes of worms so that they may be in the most favorable condition for subsequent study, different mixtures are called for, yet, for all but the most special purposes, killing and preservation in 5% formalin will serve well. This may be carried in the form of formaldehyde, which is inexpensive and less bulky than alcohol, and diluted with water as needed. For large specimens, 10% formalin (one part of formaldehyde to nine parts of water) is desirable unless the collector will have an opportunity to change the preserving fluid should it become too greatly diluted. The addition of about one part of glycerine to twenty parts of the diluted formaldehyde is of value to prevent complete desiccation of specimens in case of evaporation of the preservative.

Before killing worms, it is always a good plan to wash them free of mucus and other matter. This may be done by vigorously shaking them in water in which a little less than 1% of common salt has been dissolved to form a physiological saline solution. Nematodes and Acanthocephala tend to curl up when killed in cold fluid. It is highly desirable to prevent this by heating the killing fluid into which the worms are to be dropped to about 70° C. (160° F.).

Identification.

For the identification of tapeworms it is usually necessary to have the head whereby the worm attaches itself to the wall of the

intestine. For nematodes, the male worms, which are frequently smaller and less numerous than the females, are often essential for the identification of the species. The collector need never fear to collect too much material of any one species.

If material is sent to me at the Museum of Comparative Zoölogy, Harvard University, I will always be glad to furnish the collector with identifications of his collection. Additional hints and some equipment can be had by prospective collectors on application to the writer.

More comprehensive information on the methods of collecting parasites is contained in pamphlet No. 12 of the series "Instructions for Collectors," published by the British Museum (Natural History), London.

BOTANICAL COLLECTING.

By David H. Linder.

Because most scientific institutions dealing with the taxonomic side of biology are severely handicapped in their endeavors by the lack of abundant funds for subsidizing professional collectors in the field, the traveller to out-of-the-way places has a remarkable opportunity to assist greatly in the accumulation of facts that aid in clarifying questions of scientific and intellectual interest. But science alone does not profit, for the collector of specimens greatly enriches his experiences through the wider interests that develop with the increasing observation of the fauna, flora, and geography of the region through which he travels. Incidentally, the habit of making collections is one that stands the traveller in good stead during unavoidable delays.

Equipment. For those who intend to make botanical collecting a side-line of their trip, the equipment needed is neither complicated nor expensive, although it may prove a bit bulky for light travel. The amount of equipment will vary with the type of travel, the amount to be spent on transportation, the amount of work planned, and the time spent in the field. The following list, however, is fairly complete and should enable the collector to gather a goodly number of specimens:

2 to 5 flower presses, preferably of ash and strongly put together with copper rivets.

4 to 10 webbing trunk straps, 6 feet long.

250–500 blotters: 16½ x 11½ inches, medium weight, and absorbent.
1,000 or more sheets of news-stock or old newspapers.
25 to 50 ventilators: 16½ x 11½ inches, double faced cardboard, the corrugations running lengthwise.
5 to 10 pounds of naphthaline flakes.
1 or 2 pairs of pruning shears, if many trees or shrubs are to be collected.
1 collecting trowel or botany pick.
1 large vasculum of rugged construction.
2 balls of light twine.
50 feet of clothesline.
Waterproofed tarpaulins or ponchos for covering presses while on the march.
2 large notebooks.

The above equipment should be sufficient for one person for three months or more of rather intensive collecting, but in addition to the above, should the trip be planned for a region in which post-offices are few and the mail service infrequent, it would be well to be provided with tin boxes twenty-four inches long, eighteen inches deep, and eighteen inches wide, which when tightly packed with thoroughly dried plants could be soldered to keep out moisture. The best type of box is equipped with a grooved upper edge, and and the lid is provided with a flange which should fit snugly into the groove. These tin boxes should be protected by wooden boxes of half-inch stock, the cover hinged on one side, and provided with a hasp and lock on the other. When made in the manner just described, the boxes may be used until needed for the storage of specimen, for the transportation of the botanical equipment and other supplies as well. It would be safe to figure that between one hundred and fifty and two hundred numbers of specimens, depending on the proportion of woody to herbaceous plants, could be accommodated by each box. A shipping box of tin would require the addition of solder, a good soldering paste, and a heavy soldering iron to the list given above.

The type of material to gather will depend upon the seriousness with which the traveller intends to go into the business of collecting. If it is his intention to gather a representative flora of the region then he should collect everything. On the other hand, he might be interested in such special plants as those that furnish native food,

clothing, dyes, medicine, arrow or fish poison, or that enter into the folklore of the region. Still again, he might be interested in correlating the type of flora with the geology and climate of the country through which he passes.

The collector is advised before leaving to get in touch with the curators of the herbarium in which he plans to have his plants identified for they will be only too glad to give helpful advice and may be able to give letters of introduction to local people who, because of their knowledge of their region and their contact with others, may prove capable of rendering assistance.

Collecting Flowering Plants and Ferns.

Before going into the field, it is well to decide on whether one is going to keep the plants listed in a notebook or whether necessary information is to be jotted on the folder in which the plants are to be pressed. The advantage of the notebook is that all plants from one region will be listed together, with any additional information, such as the size, general appearance, color of the flowers, and native uses. With this information all together and correlated with the geography of the country, it can be used readily at a later date as a source of material for lectures or articles for publication. When, on the other hand, the data are written on the folders, they become widely scattered and difficult to arrange in an orderly or natural sequence. Even though there is no intention on the part of the collector to lecture or write about the botanical aspect of his trip, he should bear in mind the fact that the person who is determining his plants needs a certain amount of information, and this would greatly expedite the work of classifying many species.

For the taxonomist, there are certain questions that should be answered. Is the plant an herb, woody vine, herbaceous vine, undershrub, shrub, or tree? Is it aquatic, epiphytic, or parasitic? Does it produce a resinous, milky or colored juice? If a tree, is the trunk columnar, buttressed, smooth, spiny, or with rough scaly bark? Are branches produced a short distance above the ground or are they confined to the summit of the trunk? Are they opposite, alternating or in whorls? If herbaceous, does the plant produce tubers, bulbs, runners or suckers? Is it erect, ascending or creeping? And, finally, what are the colors of the flowers? Many of these questions can be answered by a photograph. Even though the questions seem numerous, they will not appear so complicated in the field, for then the collector will be

struck by outstanding characters and it will be the most natural thing in the world to jot them down, time permitting.

When possible, three to five complete specimens should be collected, but if only one is found that one should not be passed by because it may be that the solitary specimen is new to science or if not new, very rare. The reason for collecting at least three specimens becomes obvious when it is realized that, in many instances, duplicate specimens must be sent to other institutions to be identified by specialists. When this is done, it is usually the custom for the person classifying the plant to keep one complete specimen for his own herbarium as a reward for the labor of determining the species. A complete specimen is one that shows as far as is possible in the limited space available on the herbarium sheet, the manner of growth, the flowers, and when present, the fruit. If the plants are of the herbaceous type, that is, non-woody, the whole plant, including the room should be collected. The same holds true for ferns, but, in collecting them, both the sterile and the fertile fronds should be preserved.

Back in camp after a successful foray, the next step is to take care of the specimens. They should first be carefully sorted according to species, and then they should be roughly grouped into three general categories: (1) tender and easily dried herbaceous plants; (2) tough, woody, and easily dried plants; and (3) thick, succulent and slowly dried plants. It is usually best to put them in the press in the order given because, if succulent plants are indiscriminately scattered through the press, the excessive amount of moisture that they give up tends to retard the rate of drying of the other plants and thus keeps the presses full an inconveniently long time and to increase the chances of spoilage by mildew. Whereas the succulent plants may require special treatment, it is often advisable to press them separately.

Once the plants are sorted into groups, they should not merely be thrown in between the blotters to create a hopeless tangle. The plants should be placed in the press in such a way as to approximate as accurately as possible the natural appearance of the plant as it grew in the field. This effect can often be obtained if the specimen is held suspended by the base and then carefully placed on the news-stock folder where the leaves are then straightened out and placed in a more natural position, but taking the precaution to see that at least one leaf shows the under side. When the specimen is too large for the sheet, the procedure is the same

as before except that after the lower leaves have been properly arranged, the specimen is then folded diagonally back on the sheet and the additional leaves are then arranged, care being taken to see that the flowers are not obscured, and that the leaves do not cross the stem to obscure the manner of branching. While it is best not to cut out leaves or branchlets, if it is found that the leaves or branches make too bulky a specimen or obscure the natural appearance, then some may be removed, but a part of such leaf or branch should be left to indicate the removal. Frequently, both flowers and leaves give considerable difficulty because of their tendency to curl and wrinkle. This can be avoided by wetting small pieces of news-stock against which the flower or leaf, after arrangement, is gently pressed. Still other forms cannot be handled until after they have wilted. These can best be arranged when the blotters are changed on the following day.

Thick, succulent plants, such as orchids or live-forever, often give considerable trouble unless special facilities for drying are available. If they are not specially treated they may remain in the press for two or three weeks, and may still be alive and growing even then. The easiest way to handle these specimens is to dip them in a kettle of boiling hot water and leave them there until all the air is driven out and the plant takes on a watery, translucent appearance. The plant thus killed loses its moisture much more rapidly and, because it dries faster, the color is better preserved. It is advisable to sprinkle naphthaline flakes around such plants while they are in the press in order to prevent the growth of destructive mildews and the ravage of mites.

Aquatic plants as a rule are readily cared for, but the more delicate ones may have to be floated out in order to make a more presentable specimen. Small plants may be spread out in a photographic tray or some other shallow vessel. Once they are arranged and separated in the water, a piece of paper is slid under them and is then carefully withdrawn with the plant in such manner that, as the water runs off the paper, the leaves will not cling together.

If they do cling, it is easy to rearrange the plant with forceps or a slender, pointed stick plus a few drops of water. If a shallow pan is not available for the process, the plants should be arranged as naturally as possible on the herbarium sheet and the remainder of the job can be done by carefully pouring water on the parts that need to be separated. Whichever method is adopted, it is very desirable that dirt and other foreign matter be removed before an

attempt is made to mount the plants. The technic outlined above is also suited for the preparation of fresh and salt-water algae, excepting that the specimens should be protected by a layer of cheesecloth in order to prevent them from sticking to the blotter or to the herbarium paper.

Before proceeding to the methods of drying specimens, it would be well to give a few hints that may help to economize on effort and supplies. The news-stock as it is purchased by the collector is about the same size as a page of the ordinary newspaper and hence has to to be folded before it will fit into the press. If, for example, five specimens of one species, to which is assigned a number, are being pressed, only one folded sheet of news-stock need be used; the remaining four specimens can be pressed on half-sheets. The number assigned to the species and other data need only be placed on the folded sheet, whereas on the half-sheets only the number, and it should agree with that on the folder and with the one entered in the field notebook. The writer has found that a serial stamping machine that can be set for serial numbering, duplicate, or repeated numbering expedites matters considerably, as do also a date stamp and an office lettering stamp. The last can be set up and used constantly while the collector remains in one locality, and, even when frequent changes have to be made, it will be found that the amount of time necessary to reset the type is more than made up for when large numbers of specimens have to be labeled. In addition, the legibility is always perfect, whereas when notes are hastily scrawled by hand and in pencil, deciphering becomes problematical.

The problem of drying plants is one of minor importance to the traveller in arid regions, or to one who goes from place to place by auto or steamboat, because, to him, abundant heat is always available. It is in regions of prolonged fogs in the north, or of high humidity and excessive rainfall in the tropics that the problem becomes difficult. Two methods are suggested. The first is probably the simpler when intensive collecting is being done and when some assistance is available; the second is better when one has to rely on his own effort and has only a few presses to care for.

The first way, then, is to build a platform according to the general plan illustrated by Figure 15. The platform should be constructed of green wood in order to obviate the danger of its catching on fire, and this is especially important if the platform is to be used for any length of time. If the two horizontal crosspieces are heavy enough, they will last for some time. The shorter and more slender

crosspieces should be changed if they show signs of charring. The flower presses are placed on top of the platform and, in case of sudden rain they should be quickly covered with a poncho. The disadvantage of this system is that the fire has to be watched constantly and the presses turned at intervals. If one is lucky enough to obtain the services of a conscientious native or is able to add this chore to the camp cook's other duties, all will go well, but it is the writer's experience that natives are not always to be trusted with this responsibility.

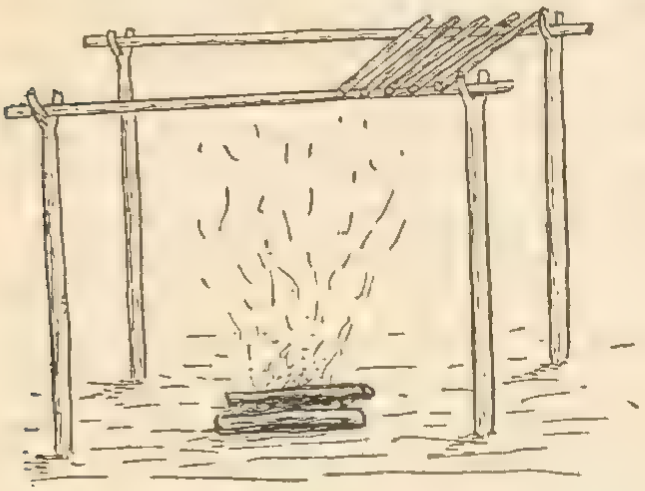


Fig. 15.

The other method, which proved remarkably effective in the American tropics when the writer was on a solo expedition, is to suspend the flower press from the ridgepole of the tent or from any supporting structure that the shelter provides. The press should hang three or four feet from the floor. Around it is wrapped a piece of oilcloth which should fall to within six inches of the floor, thus forming a chimney through which must pass the hot air, produced by a lantern placed below. The presses are provided with cardboard ventilators, and the hot air, as it passes through the channels in the cardboard, rapidly removes the moisture liberated by the plants. This method of drying plants has the advantage that the presses are constantly sheltered from the rain, that the danger from an open fire is obviated, and that constant attention is not needed. Except for the fact that a greater amount of luggage in the form of kerosene lamps, kerosene oil, and oilcloth is needed, the method is ideal even for drying a large number of presses. On a large expedition, the extra luggage would be a small item even though a special tent fly should be carried to house the presses while in use. However, certain precautions should be taken. The lamps should be filled every day in order to avoid the danger of explosion or flaring up. Also, the chimney and wick should be tested with the grade of kerosene that is to be employed, because even though the lamp may burn with a clear hot flame when tested with the more

highly refined oils obtained in the United States, when the cruder oils that are sold in the tropics are used, the heat produced is inversely proportionate to the amount of smoke that belches forth, and it would seem that nothing can be done to correct the trouble.

Whichever method is selected for drying the plants, the presses should be opened every day or every other day in order to substitute dry for wet blotters, to arrange leaves that have accidentally been folded, and to take out the plants that have dried. It may prove desirable, also, to insert extra ventilators in order to speed the drying process.

As the specimens are removed from the press, they should be sorted according to number and made up into bundles which should not exceed two inches in thickness. They can then be packed where they will be protected from dampness. Since nothing is moisture proof in the tropics unless hermetically sealed, these bundles should be placed in the sun at every opportunity. When there are enough to fill one of the tin boxes mentioned in an early paragraph, they can all be packed at once and, after they have been generously sprinkled with naphthaline flakes, the tin can be soldered with the assurance that the plants will arrive at their destination in good condition. If, on the other hand, one is conveniently located near a shipping point, the specimens may be sent home at frequent intervals and thus can be avoided the necessity of constantly watching the dried material. Even though plants are shipped at frequent intervals, and especially when the specimens have to be transported over long distances in the hold of a ship, it is always advisable to take the precaution of sprinkling naphthaline flakes throughout the packages. Above all, do not substitute paradichlorbenzol for the naphthaline flakes because the former attracts rather than repels moisture and, whereas its fungicidal action appears to be rather small, there is the possibility that the specimens treated with this substance may become moulded.

Collecting Mosses, Lichens, and Fungi.

It is unfortunate, but true, that few expeditions and even fewer travellers pay any attention to the lower forms of plant life. The explanation lies in the fact that not only are the plants usually inconspicuous, but also because they belong in groups that are little known to the lay traveller, and interest in them is more difficult to arouse. These groups, however, with but few exceptions, require much less attention as far as the making of specimens go,

than do the flowering plants since they may be readily dried, few notes need be made and these for the most part are confined to the date and locality of collecting, the color, and consistency, and the substratum upon which the plant grows. Since these lower forms show such a diversity of form and appearance, and especially is this true of the fungi, it seems desirable to consider them by groups in the following paragraphs. However, it is impossible to give a very definite description, and for this reason those who intend to collect cryptogams or nonvascular flowerless plants should by all means visit an herbarium and ask the curator to point out the different types of material, particularly those forms that might prove of interest to the collector.

Mosses and lichens, although two entirely unrelated groups, share in common similar types of habitats. They both grow on the ground, on rock, or on dead and living trees, and, in the tropics, on the surface of leathery, broad, and fairly persistent living leaves. Since the species of both mosses and lichens dry readily, they need only be placed in a paper container and exposed to the heat of the sun, or else to the radiations from the camp fire to dry. Naturally, it would be of great assistance to the curators of herbaria if the specimens were carefully sorted to species and nicely pressed to show the vegetative and fruiting bodies, but even this is not necessary since the material can be moistened and then sorted and pressed after its arrival at the herbarium. A sorting of obviously different species, however, is highly desirable and should be done in the field when time permits. Nothing is more exasperating than to have to prepare specimens from clumps of either mosses or lichen that are balled up and composed of several species.

The type of container is a matter of personal choice. Some collectors prefer to employ different sizes of kraft paper bags, such as are used in grocery stores. These possess the advantage that the time-consuming chore of folding envelopes is done away with. There is also a further advantage in that, after specimens are dried, by folding over the open end of the bag one or two times and catching the fold with a self-piercing paper-fastener or with a paper clip, the bags are closed with the assurance that they will remain so. The smaller-sized bags, number 2 or 4, will be found most frequently useful, but it is advisable to have on hand a few larger sizes, for example, number 6 or 8.

The other type of container is merely an envelope of newsstock folded as shown in the adjoining figure 16. The first fold

is made along line *AA* so that the flap which forms the body of the envelope falls just short of line *BB*. The upper narrow flap is then folded down over the lower one along *BB*, after which the ends are folded backward to complete the envelope. The drawback of this type of container is that with handling, the ends constantly unfold and when the packet is well filled with material, the upper flap either tears or bulges open, hence, there is always the risk of losing or mixing specimens. On the other hand, the envelopes keep the specimens flat, and because they can be made of a size to suit the material, they are somewhat more economical of space.

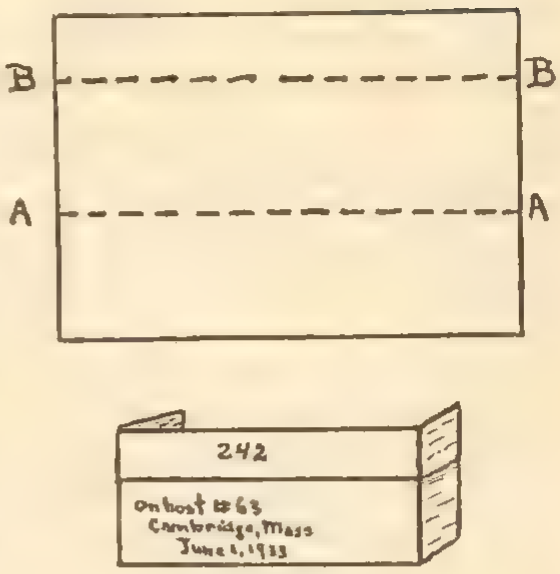


Fig. 16.

All packages containing the same species from one locality should be given the same number and, as for the flowering plants, labeled with the place and date of collection, and in addition, it should be stated whether the specimens were growing on rocks (granitic, limestone, sandstone, etc., if known), on soil, or on trees.

The substratum of leaf-inhabiting forms is obvious, since they are collected and pressed *in situ*.

If weight is not important, certain of the lichens that form a thin, although often conspicuously colored crust on rocks may be collected. While some species may be found on rocky fragments, many must be chipped from boulders or ledges with a hammer and cold chisel. For such specimens, either tin tobacco boxes or durable cloth bags make the best containers.

Fungi, because of their diversity of appearance, are rather difficult to describe to the lay traveller, and for this reason those who are interested in collecting these lower organisms should visit an herbarium in order to have demonstrated the most common types. However, they can be divided into three general categories: (1) Forms living in or on the leaves of higher plants. (2) Aquatic forms. (3) Wood or soil inhabiting forms.

(1) The leaf-inhabiting forms attract the attention of the passer-by, either because they form a superficial black, sooty layer or

spots on the leaves, or because, as a result of their activity within the host, the green pigment of the host is locally broken down and yellow, orange or brown spots may result. The size of the spots may vary from one-quarter of an inch or less to two or three inches in diameter, and the outline may be circular or linear or any variation within these two extremes. But leaf-spots should not be collected for the variations in size and design. They should be examined under a 10X or 15X hand lens on both sides to determine the presence or absence of fungi which may be in evidence as small black spots imbedded in the host tissue, as blisterlike swellings, as white or dark cottony or powdery growths, or as light or dark-colored creeping threads. If the host is not well known to the collector, a good specimen with flowers and fruits should also be pressed at the same time, for an accurate knowledge of the host species saves considerable time in determining the name of the parasite, and often may prove to be indispensable. For this reason, then, the label on the packet should include a cross reference to the host number and the data should read somewhat as follows:

No. 242
On host No. 63
Cambridge, Mass.
June 1, 1933

(2) The aquatic forms, although belonging in a fascinating and beautiful group of fungi, have scarcely been collected on expeditions. It is, therefore, a practically untouched field of endeavor for the traveller in the tropics. They should be looked for in pools, ditches, along the margins of ponds or lakes, or in slowly flowing streams, in which places they will frequently form white halos or tufts of slender threads that radiate from dead worms, insects, fishes, or from fruit and twigs which have fallen into the water.

Should the explorer be stationed at a base camp for any length of time, say two weeks, he has an opportunity to set out lines of bait, the bait consisting of either firm fruit or berries, or green twigs. These should be pricked or slightly slit with a sharp knife or scalpel, and then fastened to a line which may be tied to some bush or limb along the edge of the body of water. If many such bait lines are put out, it may prove desirable to indicate their location by tying white rags to the anchorage, but this procedure sometimes proves disastrous, since natives, filled with curiosity, may be tempted to pull in the lines with high expectations, and finding nothing but

twigs or fruit, drop the bait on shore wondering what fools we mortals be.

Once the aquatic species have been found and the type of habitat observed, further collections come with ease. To preserve such forms, they should be placed in one-half ounce or one-ounce vials that have been fitted with a good grade of cork stopper. The preserving fluid may be 2% of commercial formaldehyde in water, 60% to 70% alcohol, or a combination of both. Formaldehyde possesses the advantage that it is very concentrated and therefore larger quantities can be taken into the field in the minimum amount of space, but it is not the ideal preservative since it causes a shrinking of the cell contents. Another preservative which offers certain advantages is a concentrated solution of lactophenol made up according to the following formula:

Lactic acid	10 grams
Phenol (carbolic acid)	10 grams
Glycerine	20 cubic centimeters

This solution may be diluted to one part in ten to twenty parts of water as needed. The mixture is of a syrupy consistency and therefore the danger of total loss if the bottle is tipped over is greatly reduced. Care should be taken, however, not to spill the concentrated stock solution on the skin because of the caustic action of the carbolic acid.

Once the vials are filled, the stoppers should be held in place by strapping with narrow strips of adhesive plaster. One strip should extend from one side of the vial over the top of the cork and down onto the other side of the vial. This strip should then be held in place by wrapping a second strip around the top of the vial. Surgeon's plaster also makes the best type of label because subjection to alternate damping and drying does not cause it to peel off, and also because the data can either be stamped on it or written on with a pen or indelible pencil.

(3) The wood and soil-inhabiting forms often attract attention because of their size, shape, or color; yet many interesting ones pass unnoticed, either because of their inconspicuousness or because they grow on the under side of fallen bark, limbs, dead leaves, or boards on which they form a light, cottony or dark, short-velvety layer. Other species produce a thick and clearly marked, often brightly colored, smooth or porous layer. Still other species grow into cushion-shaped, hemispherical, or even branched fruiting

structures. All such forms, even though gelatinous in texture, may be cared for by simply drying them and placing them in packets as mentioned for lichens and mosses. The data on the packets, however, should include the substratum (host name if a living plant), and notes on color and consistency (dry, waxy, gelatinous) of the fungus.

There are certain groups of the wood-inhabiting species that need especial attention in collection and preparation; namely, the phalloids or stink-horn fungi and the agarics or gill mushrooms. The former may be cared for in two ways. They may be preserved either in alcohol or in the diluted lactophenol solution already mentioned in connection with the water-moulds. It may not be convenient for the traveller, however, to transport pint or quart preserving jars, in which case the next best thing to do is to dry the specimen in a flower press. When this is to be done, the specimen should first be allowed to wilt until it loses its brittleness. It is then placed on a half-sheet of herbarium paper covered with wax paper, and afterward placed between the blotters of the press, which should not be tightly closed but rather should have only enough pressure applied to keep the press from sliding or falling apart. Usually, all that is necessary is to place the press on a flat surface and to put on it only two or three pounds of weight. It is always desirable to photograph the plants while in a fresh condition, because on drying they lose some of their outstanding characters and it may then be difficult to determine the species. Failing a photograph, a water-color, or pencil sketch often proves a distinct aid to classification.

Of the gill mushrooms, there are two types: a leathery type which can be dried readily and a fleshy type which rapidly decomposes. Concerning the latter, a few words need to be written because, if the instructions are not followed, it may prove well nigh impossible to determine the species.

Whereas the fleshy fungi are usually very fragile, care should be taken always to keep the lighter specimens above the heavy ones in the vasculum or market basket, whichever is employed. Also, each species, as collected, should be placed in a paper bag or else loosely wrapped in a piece of newspaper in such fashion that it will be protected from crushing and shaking. Whenever possible, at least five specimens should be collected and they should show as many stages in the development of the fungus as possible.

Promptly after returning to house or camp, the specimens

should be sorted and the fleshy or putrescent forms studied first and notes recorded on their color, structure, and habitat. Because the generic position of the plant is often dependent on spore color, spore prints should be made. To do this, the stem should be cut off at a level with the bottom of the cap, and the cap then placed on a piece of white paper, gill side down. The remaining specimens may then be placed around the cap in such a way as to protect it, and the four corners of the wrapping paper on which the pile of specimens is placed should be brought together and twisted so as to form a protecting cover. Then the package of plants may be placed back in the basket. If bags are used instead of a wrapping of newspaper, the cap from which the spore print is to be obtained is placed in the bottom, the remaining specimens carefully put in around and above it, and then, after closing the opening of the bag, the bags are placed vertically either on a shelf or back in the basket and allowed to remain for three or four hours, or overnight, after which time the specimens may be taken out of the sacks or wrapping and dried in the sun or in wire trays over a fire.

Before the drying process is begun, or better still, just after the specimens are sorted, notes should be taken and should answer the questions indicated by the following form as listed by Kauffman in the "Agaricaceæ of Michigan":

Locality
Date
Finder or collector
Weather
Habitat: ground, leaves, humus, woods, open grove, field, lawn, wood (kind), tree (kind), moss, dung (kind).
Habit: solitary, scattered, clustered.
Odor: pungent, nauseous, nitrous, etc.
Taste: bitter, peppery, mild, slight, etc. *Danger:* see below.
Pileus: size. Shape when young; conical, campanulate, acorn-shaped, cylindrical, convex.
Shape when expanded: plane, convex, obtuse, umbenate, umbilicate, depressed.
Surface: viscid (slimy), dry, hygrophanous (changing color in drying), moist, smooth, silky, fibrillose, floccose, scaly, even, wrinkled, striate, furrowed (radially or concentrically).
Color: (when fresh and moist) (after lying a while) *IMPORTANT.*

Gills: attachment: adnate, partially free, or free, or running down stem.
Width: in millimeters or relative to thickness of pileus.
Shape: linear, equal in width, attenuate, broadest near or away from stem, etc.
Spacing: crowded, close, distant.
Texture: dry, waxy, or deliquescing.
Edge: thick, thin, irregular, or flocculose.
Color: when gills are young and when mature, after bruising.
Stem: size and shape.
Texture: fleshy, cartilaginous (making a clean break when strongly bent), spongy, rigid.
Interior: hollow, stuffed with loosely arranged threads, solid.
Surface: see *Pileus.*
Color: at base and at apex, within and without, and after handling.
Flesh of Pileus: Consistency: compact, spongy, soft, brittle.
Color: when moist, under cuticle.
Juice: taste, abundance, and after exposure to air.
Annulus: if present, whether a free or attached ring around stem.
Volva: whether cup or as coarse scaly fragment around base of stem.
Color of Spore: make spore print.

The above is a long list of observations to make but, unfortunately, they are necessary for the accurate determination of the species. However, many of the points listed above may be more easily and rapidly indicated by a sketch of a longitudinal section of the fruiting body and, if made natural size, may do away with the necessity for making measurements.

Caution. In tasting specimens, especially if their edibility is not well known to the collector, only a small bit of the flesh should be placed in the mouth, crushed for a few seconds, and then be spit out. It is dangerous to taste any species which have white gills, a ring around the stem, and a cup at the base, and it is because of the last point that all mushrooms should be dug up rather than snapped off at the level of the soil. Forms so characterized belong in the deadly poisonous genus *Amanita,* which includes, among others, the Fly Amanita and the beautiful though exceedingly poisonous Angel's Death Cup.

One last word about the care of the specimens. Just before they

are put away to dry, a light sprinkling of naphthaline flakes should be added to the packets. This kills the insects already present in the living specimens, and keeps out mites, buffalo bugs, and others, as well as reduces the chances of disastrous infections by moulds.

COLLECTING FOSSILS.

By W. E. Schevill.

The incidental collecting of fossils need not make great inroads on the time of travellers, nor distract them much from their chief purpose. Usually, all that is required is to pick the specimens up, label, and pack them. Briefly defined, a fossil is a trace of an organism preserved in the rocks. It may still have some indications or vestiges of its soft parts, but it is much more likely to consist only of hard parts or traces thereof. It may be practically unaltered; it may have been completely dissolved, leaving either a cavity or a rock cast; it may have been delicately replaced by mineral matter (petrified); or, again, it may be a mere impression, as for example a footprint. (Fossil indications of soft parts are mostly of this nature.)

Except to say that fossils are not to be expected in regions where only igneous rocks are seen, it is difficult to offer any general rule as a guide in searching for them. Look at rock outcrops; where these are scarce or not readily to be seen, try steep slopes and cliffs, creek banks, and artificial excavations, such as quarries or road cuts or the material dug out of wells. Fossils may also be found in stream beds, in detrital material along the shore, or even weathered out and scattered through the soil. In short, fossils may be expected anywhere that sedimentary rocks (as sandstone, limestone, shale, cave deposits, etc.) are being attacked by erosion and denudation.

Although the larger fossils are perhaps more likely to be spectacular, they are not necessarily any more interesting or valuable than small ones; large specimens are certain to be more trouble to collect. Small fossils in soft rocks are quite easy to attend to; very little care is needed in extracting them. Hard rock involves the use of a hammer or even a chisel to break off bits of rock containing fossils. No attempt should be made in the field to clean the rock entirely from the fossil — that is much better left for the laboratory.

In packing, all that is necessary is padding sufficient to keep the

specimens from rattling about, though it is important to wrap them well individually at first. Fragile specimens may often be strengthened for removal by repeated impregnations with thin shellac. Large fossils may be handled in the same way if they are strong enough to withstand transport. If they are fragile, the matter becomes more complicated, involving the use of shellac and bandaging with flour paste or plaster of Paris or both, reenforced with something like burlap or sacking.

Probably the most important single item in the whole matter of collecting is the labeling. All specimens should be thoroughly documented as to the locality in which they were found. This should be as exact as practicable, not merely to enable one to revisit the locality if desired, but primarily to enable the worker at the home museum to locate it on a map. It is, of course, always desirable to have any possible information relating to the geological position of the fossils, although this cannot always be expected of the casual traveller; some valuable suggestions under this head may be found in the section on Fossils in Chapter XIX, page 299.